TECHNOLOGY, CAPITAL, AND GOVERNMENT FISCAL POLICY

BY

WILLIAM EARL SCHENK

B.S., Montana State College, 1934

A.M., University of Michigan, 1939

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ECONOMICS
IN THE GRADUATE COLLEGE OF THE
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I. Cost and its Reduction

Technology is the application of organized knowledge to reduce cost. Capital is land processed so as to serve as a means of reducing cost, and thus is the vehicle through which technology is applied. One of the essential factors in the development of capital, and hence in the rate at which technology develops and is applied, is government fiscal policy. This study explores some of the key relationships among these three major phases of the connection between organized knowledge and economic affairs.

As a preliminary, it is necessary to analyze briefly the fundamentals of cost. This must be computed in terms of the human individual as the basic element, or "atom". It then takes on three dimensions: Time, physical energy, and psychic cost. Time is the inflexible dimension of human existence, a rather definitely fixed proportion of which must be devoted to rest and recreative activities; the remainder then is divided between purely instrumental or productive activities, and terminal or consumptive ones. The latter fulfill directly the ends of the individual performing them, the former create means, in some fashion, to these ends. To any given individual, all instrumental activities involve cost, while from his point of view activities resulting directly in terminal values constitute no part of cost. Physical energy also must be expended upon activities of both types, but for instrumental activities, at least, can be very largely furnished by non-human sources, though all terminal activities will still require some exertion on the part of the one engaging in them. Cost will reach an optimum when no human being expends time or energy upon wholly instrumental activities.

A less definite and well-understood form of cost is psychic

cost, which grows out of worry, fear, or uncertainty, or any feeling of insecurity on the part of the individual or those with whom his interests are identified; or may grow in a different way out of definitely predictable monotony, fatigue, or strain. In general it develops out of dislike for a given task, preference for another activity, or some other factor leading to lack of willingness to perform a required activity. It is closely connected with the situation known to psychologists as frustration, and can be diminished by greater security for individuals as well as by mitigation of undesirable or irksome aspects of instrumental activities.

Technology may be applied to reduce cost in any of these dimensions or any combination of them. It is applied through development of non-human production resources to replace human ones. Thus its primary requisite is creation of capital through some form of the saving process. But as it diminishes cost in terms of time and physical energy, it often simultaneously involves an increased incidence of psychic cost. This is closely connected in turn with the nature of incentives.

Individuals engage in activity for some combination of three reasons. They enjoy it in itself; or they view it as a means to the acquisition of tangible, material things, or the intangible rewards of prestige and power over other individuals. Before any individual will engage in a given activity, the terminal values to whose enjoyment it leads must, in his view, outweigh its cost in terms of the instrumental activities it entails. Whether or not a given activity is enjoyable in itself is partly a result of the unconcious institutional outlook of the individual.

Institutions are the controlling relationships among human beings, that determine the forms their organizations will take. They operate at three levels. Obedience to them may be unconscious and involuntary, possessing then a strong influence on the nature of terminal values for individuals and leading often to a degree of resistance to innovation; it may be conscious but involuntary, in which case such institutions are

important sources of cost, particularly of the psychic variety. Or, adherence to their precepts may be both conscious and voluntary, and possess either terminal or instrumental value. In the latter case they also are important sources of cost.

The reduction of cost, then, may operate along any combination of these three major dimensions of cost. It may decrease the amount of time individuals spend in purely instrumental activities, or convert the latter into activities possessing terminal value, or both. It may diminish the required expenditure of physical energy upon instrumental activities, through creation of capital to replace labor in those activities. And it may diminish the incidence of psychic cost by reforms in organizational relationships and procedures, preferably through changes at as fundamental a level of institutional relationships as possible.

The problem, then, is the development, as far as can be done, of an institutional environment that will generate the minimum of cost associated with a given total of utility; and which, at the same time, will furnish incentives to the development and acceptance of cost-reducing novelty, at a rate dependent upon three variable factors: Available facilities for saving and capital construction and accumulation; the extension, transmission and refinement as well as the application of knowledge; and the ability and willingness of society, through management and through government, to adopt and benefit by such novelty. It may be possible to apply these incentives through the fiscal and monetary systems; if these prove inadequate, more direct, possibly coercive action by government may be required.

II. Technology as A Process of Innovation

The field of technology consists of applications of knowledge to reduce cost. To achieve this, knowledge must be extended, preserved, transmitted and applied; and incentives of suitable sorts are needed to bring about each of these stages of the

process.

That of the four stages most motivated by pecuniary considerations, and thus most responsive to reactions through the price system, is the last. It is more predictable in its financial rewards and more definitely related to extrinsic, instrumental incentives than the others. By a rather weak and uncertain imputational process, however, promise of reward at the level of application may bring about some degree of stimulation of the other phases; and even the extension of knowledge through pure research, the least predictable and hence also least responsive to extrinsic incentives, of the four stages, may feel this stimulus.

Currently the chief incentive to extension of knowledge, besides the minor ones arising from the intrinsic pleasure of the activity itself, is its instrumental value in connection with promotion and increased monetary reward in the educational system. The institutional complex within which these incentives operate is such as fails to respond smoothly to human needs and wants as transmitted through the price system; this factor, together with the lack of predictability of financial reward for pure research, results in frequent failure to extend or integrate knowledge in many directions that might fill important gaps in the satisfaction of human wants. For similar reasons, medical techniques fall partly outside the nexus of pecuniary motives, and even when known may fail to be applied, or developed, to the extent necessary to render them useful to the optimum degree among consumers. To perhaps a lesser degree, the same is true of educational technology; this is rather inefficient and unnecessarily costly, and lags far behind the currently possible level of mechanization and individualization. It appears rather likely that lack of certainty of financial reward, and perhaps also lack of competitive pressure, particularly in education, is the key factor in the slow rate of development and acceptance of innovation in those two fields. For these reasons, government activity to improve pecuniary relationships between application of

knowledge in these fields, and rewards for such application, appears to be indicated. The method of doing so that will best extend the normal operation of the price system to these areas of activity, is that of direct grants of purchasing power to consumers that may not be expended in other fields.

Pure research may not be greatly stimulated, or directed toward goals essential in terms of social importance, without some central direction and control. This should probably take the form of direction and stimulation of research activities toward the most generally important areas of knowledge still unexplored. This should lead, within rather wide limits of predictability, to such improvement in knowledge as will contribute to reduction of cost in terms of time and human energy.

An important related aspect of such activity is that it can be employed also to reduce the total of psychic cost resulting from fluctuations in the level of employment. Through proper control and direction, unemployed could be trained or retrained, and young scholars and research workers developed, through a program that would simultaneously further the development of organized knowledge, and stimulate the process of criticism and innovation that is the essence of invention. Such a program might be both financed and controlled by government, or merely financed by it, with control placed in the hands of scientists and scholars outside the employ of government. Little choice appears between these two methods of guidance.

Both pure and applied research may be improved and facilitated by scholarships awarded on a basis of merit, either of ability or of proposed projects, for purposes either of further training or furtherance of research, both of which ends could be served at the same time. Most such activity should be directed into fields of pure research, the extension and improvement of knowledge itself, leaving to private initiative the processes of application, development and production which offer direct financial reward. Programs,

privately financed, of industrial research might well arise in connection with such stimulation of theoretical developments.

Because of the basic importance of artificial energy supplies as agencies for reduction of cost in terms of human energy, special attention should be given this field of development. Previous studies indicate that the relationship between national income and total energy expended in its creation is highly stable, fluctuating only within narrow limits. Hence any increase in the national income without increase in cost can be achieved only if supplies of artificial energy are more extensively available. The most promising additional source of such energy is atomic fission, which is still not developed to the stage of economic practicality. This and related fields are those most definitely indicated as possibilities for further exploration.

III. Capital, Innovation and Monopoly

Capital is the means through which knowledge is applied to reduce cost to human beings. It is land processed to replace labor. Two phases of cost reduction through development and use of capital can be distinguished, one the simple replacement of men by machines, the other replacement of machines by more efficient or less costly ones.

Machines to replace men are created through the process of invention. Under our present institutional organization they will enter into production only if they prove cheaper than the labor they replace. To insure continuing pressure toward the adoption as well as the development of capital, some general governmentally-instituted action may be necessary to render labor relatively more costly than capital. If this becomes advisable, a general forced reduction in hours per week, month or year that a given individual may be employed, with severe penalties for overtime, is the simplest solution. No reduction in money wages should be permitted, though real wages may, for a time at least, decline as the result of such

an action. The only agency capable of enforcing, or perhaps even adequately formulating, such a policy, is government.

Even new forms of capital which are relatively less costly than labor may fail to be accepted or adopted, if existing capital installations are new and undepreciated, unless competition prevails within the industry concerned, to a degree which enforces its acceptance. Thus monopoly may refuse to accept innovations which reduce cost; or to produce capital which may supersede its existing line of production but offer less returns. Monopoly thus presents obstacles both to development and production of less costly forms of capital, and to its acceptance and adoption in the production process. This may ultimately justify government instigation of competition with existing monopolies, or where this may be impossible their control, or preferably ownership, by government. This applies particularly to those monopolies which produce capital, if they in any way obstruct innovation, since any innovation which cheapens capital automatically also reduces cost of any goods for whose production it is employed. This policy also offers opportunity for government-instigated research, both pure and applied, aimed at reducing the cost of capital as well as rendering it more efficient; these are two fundamental approaches to the problem of cost reduction.

As limitations upon the supply of capital due to lack of knowledge requisite to its creation are removed, by research, application and development, its creation may still be inhibited by such monopolistic checks to its adoption. If such barriers are removed, an economic limitation can still appear due to reduction of willingness to save at the individual or institutional level. Under our current economic organization, however, individual willingness, or lack of it, to save, is of very limited importance as regards the supply of capital, which is almost entirely accumulated through saving by organizations, either through the banking mechanism, or the plowing back of earnings. Since each increment of capital renders less costly subsequent additions to the stock of it at

hand, social savings accumulate, or can do so, at an increasing rate. This is, however, able to fluctuate within extremely broad limits over time. Thus its primary dependence is upon the relative efficiency of its production compared with that of labor, as reflected in its cost. Greater efficiency in production of both consumers goods and capital, but especially the latter, could be gained by standardization of products, and in particular by reduction to simple atomistic units, of all capital installations whether adapted to produce capital itself, or consumers goods. Such a policy also would contribute to furtherance of acceptance of innovation by reducing the cost of obsolescence, and would increase the mobility of capital among and within industries as well.

Monopoly is further important in relation to capital, in that it may develop in two directions as a result of further progress of invention and innovation. Plants may become so large at the optimum as to bring about a natural monopoly of the type of public utilities; or patents intended to reward the inventor by a temporary grant of monopoly power may be perverted to render that power nearly permanent. In the first case, the best remedy appears to be government control amounting practically to ownership; the latter may, in fact, prove preferable to control. Many monopolies, however, turn out products the demand for which is highly elastic, which implies that they compete with one another and also that they may be of small importance to most consumers. The result may be that they result in no serious loss of efficiency in production, or overcharge to the consumer. In such cases regulatory activity may probably be dispensed with. The other type, patent-based monopoly, may grow quite important under our present system, which is seriously in need of renovation; its special need is improved administrative procedure and a general policy which rewards invention without fostering monopoly.

Other useful measures of monopoly control include government-sponsored competition with established, or devel-

oping, monopolies; this offers the best possibility of securing acceptance of innovation, although if one plant is ample, at optimum output, to supply the entire demand for a given product, some loss in efficiency will obtain under such a policy. Such sponsorship of competition may include underwriting of risk through credit facilities, or any degree of control of the competing organization, up to and including ownership. Here again, the latter appears simpler and more positive in achievement of the desired results. An especially important modification of this policy is government investment in fixed facilities which can be used by the consumer to produce, through his own exertions, goods he requires. These facilities can test out innovations which, if they prove financially remunerative, may be disposed of to private owners unless retention of ownership by government appears desirable for purposes of continuing monopoly control.

IV. Government Fiscal Policy and the Reduction of Cost

In connection with the general group of functions of government that tend to increase the predictability of the environment of individuals, there appears considerable opportunity for further action of a similar sort, which will serve primarily to diminish those varieties of psychic cost due to the uncertainties of individual futures, with especial regard to employment. For a general unified program to reduce cost in all its aspects, three major lines of activity will be required. First, certain econometric and statistical information must be gathered and processed as a basis for control activities. Second, fiscal policy must be formulated and applied to maintain employment at a reasonably high level. Third, perhaps also least urgent, pressure should be maintained of a sort tending to induce replacement of labor by capital. If innovation can be sufficiently stimulated indirectly through the other measures cited above, this last aspect of control may become unimportant.

The level of employment and that of effective demand are closely related, and declines in the former may perhaps best be remedied by stimulation of the latter. Along with this, employment may also be directly increased by governmental outlays of an investment sort, or by made-work programs of various types.

Such a program can be closely and directly integrated with the problem of extending and applying knowledge, earlier discussed. Three phases of the latter may be distinguished. First, the field of knowledge itself, and the methodology by which it is extended and integrated, may be scrutinized. This requires a program of pure research of the sort above cited. Second, in the field of economics itself, a more accurate and detailed analysis of demand, with periodic revision and amplification, is needed; in particular the likely demand for both pure and applied knowledge, and for personnel in the various areas of activity connected therewith, will be of value. Third, research leading to knowledge of natural resources, and to development of substitutes for them where necessary, and also to anticipation of need of additional capital or improvements in it, will be advantageous. Such programs, however, require continuity and long-term planning, and are not well adapted to employment of an intermittent nature or of untrained personnel, though some possibilities along these lines exist. A better solution for short-term employment grows out of maintenance of key personnel and minimum research programs capable of periodic expansion. But the most flexible method of creating purchasing power through employment is the provision, if necessary at government expense, of a national employment service of high efficiency, coupled with retraining programs financed by government, to bring together the man and the job. A further degree of flexibility appears in the possibility of varying the basic annual rate of compensation for Federal employees, including trainees and the holders of scholarships under the program earlier suggested, above a

guaranteed annual minimum. If public utilities and other monopolies are taken over by government, employees of these could receive such bonuses and the capital equipment of such enterprises replaced and repaired, at a flexible rate, both to maintain employment and to bring into such industries the full effects of innovation as rapidly as it appeared. Nationalization of the chief capital-producing industries might be justifiable for the latter reason even though they are not seriously monopolized. For a reasonable degree of stability over the cycle, some considerable amount of control, on a quantitative basis, of credit is apparently necessary; this can probably only be accomplished through rather stringent control, or perhaps nationalization, of the banking system. As the system of Social Security becomes progressively more integrated with such a control program, private insurance activities may be expected also to diminish, removing as they do so another inhibiting force to acceptance of innovation; and Social Security allowances can also be rendered more flexible to counteract cyclical fluctuations.

Proper implementation of such a program would bring together functions now performed by a scattered group of government officials, if they are under government control at all. Activities of the Treasury, the Federal Reserve System, and Departments of Commerce, Labor, and Interior, as well as by scattered privately-controlled organizations, would be affected. The control agency would have four major groups of functions to perform, all of which after an initial period of experiment should become routine administrative operations under formula prescribed by the legislative branch, allowing the minimum of administrative discretion or variation; this to render the system as little arbitrary, and as highly predictable, as possible.

The four branches of the agency would be instituted on a functional basis. Its Bureau of Statistics would gather and process information, both fiscal and physical, as to prices and values, production, employment, and other relevant factors

in the production situation. The Bureau of Fiscal Affairs would perform or supervise the creation and destruction of purchasing power, through credit, coinage and taxation operations, and perform accounting functions for the agency. The Bureau of Employment and Education would operate government-owned enterprises, and the employment service, and supervise the creation of employment when and where necessary. It would act on information furnished by the Bureau of Research, the fourth branch of the control agency, whose function would be planning, as to direction and scope, of research both pure and applied, assessment and prediction of personnel training needed, and the administration of the Patent Office and other branches charged with preservation and dissemination of information relevant to innovation, throughout the economy.

The agency will require a coordinating and—as far as necessary—policy-forming head, which might well be a commission chiefly or entirely composed of individuals not otherwise connected with the government, together with those Cabinet officers whose Departments' functions were involved, or possibly superseding the latter entirely. The final form of functions of this, like most other aspects of policy involved, would be best determined by experiment, then rendered less flexible and more predictable by permanent legislation defining the agency's organization and functions. The latter would center around maintenance of full employment, perhaps, primarily; but of almost equal importance would be its action to maintain a fully dynamic economy, able and willing to develop and accept a high rate of cost-reducing innovation.

VITA

William E. Schenk was born at Bozeman, Montana, on November 21, 1911. After education in Montana grade and high schools, followed by a period of farm operation in association with his father, he was graduated from Montana State College in 1934. He earned the degree of A. M. from the University of Michigan in 1939.

Between 1933 and 1944 he was connected with the Department of Modern Languages at Montana State College, leaving in 1944 to become Instructor in German at the University of Illinois. In 1945 he became associated with the Department of Economics at the University of Illinois, and in the spring of 1948 was appointed Associate Professor of Economics at Texas A & M College. His teaching experience includes courses in principles of economics, economic history, public finance, history of economic thought, and advanced economic theory. During World War II he worked with the Office of Labor of the War Food Administration, supervising the use of Mexican emergency labor in Montana; and since April, 1947, he has been Economic Consultant to the National Tax Equality Association of Chicago.

His publications include several articles on various phases of the emergency labor program during the war, one article on tax exemptions of cooperatives, and numerous contributions to the campaign for termination of those exemptions, published by the National Tax Equality Association.

He is a member of Sigma Delta Pi, Beta Gamma Sigma, and Phi Kappa Phi; and of the American Economic Association, the National Tax Association, and other professional organizations.